REACTOR CONTAINMENT BUILDING
INTEGRATED LEAKAGE RATE TEST

TYPES A, B, AND C
PERIODIC TEST

VIRGINIA ELECTRIC AND POWER COMPANY
NORTH ANNA POWER STATION
UNIT NO. 1

SEPTEMBER 1984

Prepared by
STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS

B1-1426028-5025

TABLE OF CONTENTS

REFERENCES

1. 10CFR50, Appendix J, Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors, October 22, 1980.

2. 1-PT-61.1, Reactor Containment Building Integrated Leakage Rate Testing, 1984.

3. ANSI N45.4, American National Standard Leakage-Rate Testing of Containment Structures for Nuclear Reactors, March 16, 1982.

4. VEPCO, North Anna LER 84-008, Recirculation Spray Cooler Lap Ring Cracking, dated September 27, 1984.

LIST OF ATTACHMENTS

SECTION 1

PURPOSE

The purpose of this report is to present a description and analysis of the August/September 1984 Periodic Type A Containment Integrated Leakage Rate Test (CILRT), and a summary of the periodic Type B and C test conducted since March 1981 on the Virginia Electric and Power Company's North Anna Power Station, Unit No. 1.

This report discusses both the August and the September CILRT. The containment was depressurized in August due to the suspected leak in the service water piping to the Recirculation Spray System and because the loss of trending capability caused by the tripped air recirculation fan. Remaining outage work and the subsequent repairs performed on the recirculation spray coolers delayed the second CILRT until September 1984.

Stone & Webster Engineering Corporation provided engineering consultation services to Vepco during their performance of these tests.

This report is submitted as required by 10CFR50, Appendix J, Paragraph V.B.

SECTION 2

SUMMARY

2.1 TYPE A TEST

2.1.1 August 1984 CILRT

Pressurization for the August CILRT was started at 1428 hours and was completed at 2357 hours on August 4, 1984. The "B" containment air recirculation fan tripped at 2219 hours.

During the first hours of temperature stabilization, an unusually high temperature difference within Zone E was observed. This was attributed to RTD TE-LM-100-4. This point was deleted from the CILRT program. This action extended the temperature stabilization period as the weighted average temperature was offset due to the deletion of the RTD. Temperature stabilization was achieved at 0600 on August 5, 1984.

Leakage investigation teams discovered two significant leakage paths. The first, discovered at 1640 hours was on the Containment sump pump discharge line, Penetration 38. The second, discovered at 1720 hours, was on the Containment Vacuum System, Penetration 93. Both penetrations were vented for the Type A test. The vents were closed in an attempt to quantify the effect of these leaks using the change in the mass trend. From 0600 hours to 1800 hours on August 5, 1984, the average mass lost was approximately 33 lbm/hour.

From 1900 hours on August 5, 1984, to 0600 hours on August 6, 1984, the average mass lost was approximately 16 lbm/hour. The Type A acceptance criteria of 0.75 La is approximately equivalent to 16 lbm/hour.

There were three other leakage paths noted during the August CILRT. The first was the Personnel Airlock. The personnel airlock was tested on August 31, 1984, and the probable leakage path was determined to be the valve packing on the inside personnel door equalizing valve. The measured leakage was 11.4 scfh. Although the airlock leakage contributed to the Type A leakage, it was not a significant Type A leakage path.

The second leakage path was a manual valve on the leakage monitoring system. This valve isolates the dry air pressurized bottle used to leakage test the leakage monitoring system. This manual valve is in the nonsafety related portion of the LM system and would generally not see Type A pressure due to closure of redundant containment isolation valves. Since the Type A pressure instrumentation was installed on the same nonsafety portion of the LM system, the manual valve did see Type A pressure. No appreciable improvement was observed in the mass trend before or after the manual valve was closed. In fact, the mass trend worsened. The LM manual valve leakage contributed to the Type A leakage, although it was not a significant leakage path.

The third leakage path was the Recirculation Spray Heat Exchanger (RSHXs). There are four RSHXs, all located inside containment. Service water provides the cooling water to the RSHXs. On August 7, 1984, during a review of the valve lineup, it was determined that the service water penetrations to the RSHXs were not flooded. Upon flooding the service water piping, a sustained mass increase was observed. The service water supply header pressure was monitored and found to be well in excess of the Type A test pressure, (e.g., inleakage). The header pressure was bled down, and the mass rate again decreased. Attempts to isolate the RSHX leakage by establishing a controlled water block on the supply header, and a maintained air pressure on the return header were thwarted by loss of the "A" containment recirculation fan motor at 1040 hours on August 8, 1984 (motor feed by H bus which was lost during a diesel test). The loss of the fan affected containment air temperature trending. The containment was depressurized to inspect the RSHXs.

After a series of tests, it was determined that the probable air leakage path was through cracks in the RSHX lap ring (Attachment 2.1A). As reported by VEPCO (Reference 4), these cracks were caused by a Crevice Corrosion and Stress Corrosion Cracking condition. The repairs to the RSHX were completed prior to the September 1984 CILRT. VEPCO is currently evaluating potential modifications for the recirculation spray coolers to address this condition.

The RSHX leakage was determined to be a significant Type A leakage path. Conservative estimates of leakage through this path can be obtained by comparing the improvement in average mass lost from the September 1984 CILRT (7.5 lbm/hour) to the 11 hour period immediately following the the isolation of Penetrations 38 and 93 (16 lbm/hour) during the August CILRT. The difference of 8.5 lbm/hour is equivalent to 0.4 La or 113 scfh.

The following summarizes the significant Type A leakage paths identified by the August 1984 CILRT:

Path	Leakage (scfh)
Penetration 38	53 (measurement)
Penetration 93	252 (measurement)
RSHX	113 (estimate)

The leakages for the penetrations were determined by obtaining the Type C leakages for individual valves, then by taking the lowest of the two (both penetrations have one valve inside, one valve outside). This minimum pathway leakage simulates the leakage prior to the isolation of the penetrations. The resulting leakage from these three paths is roughly 1.5 La or twice the maximum allowable Type A leakage.

2.1.2 September 1984 CILRT

Remaining outage items, maintenance work on problems discovered during the August CILRT, and the repairs on the Recirculation Spray Cooler were performed prior to the September CILRT.

In an attempt to increase average containment temperature during the September 1984 CILRT, the chilled water flow to the containment air recirculation fans were throttled using a manual valve on the supply header. The higher containment air temperature was desired partly to resolve the temperature Zone E discrepancy (TE-LM-100-4 had been verified to be functioning properly) and to stay within the new temperature range of the RTD bridges (see Attachment 3.2A).

Leakage investigation teams discovered one significant leakage path during the September 1984 CILRT. Due to the decreased chilled water flow to the air recirculation fans, the containment air pressure was now much higher than the chilled water pressure. This resulted in overleakage through the "A" recirculation fan cooler unit piping. A downstream leakage test was performed on the "A" cooler with the contain-ment pressurized. The measured leakage was 70 scfh. Following the September 1984 CILRT, the source of the "A" cooler unit piping leaking was identified as the flanges on TV-CC-105A. This leakage had not been picked up by the Type C test performed prior to the August CILRT. This leakage was not noticed during the August CILRT due to the higher flow rates, and thus the lower differential pressure across the isolation valves.

At 1800 hours on September 9, 1984, the CILRT was started and was successfully completed at 1800 hours on September 10, 1984. The super-imposed leakage test was started at 1940 hours and was completed at 2340 hours on September 10, 1984.

Depressurization of the containment began at 0101 hours and was completed at 1350 hours on September 11. 1984.

2.1.3 Conclusion

With the exception of the RSHX leakage path which has been repaired, the other leakage paths found during the August and September CILRTs are possibly the result of inadequate Type C test methods. The use of the downstream method without a leakage check of the test boundaries is not always a conservative test method. VEPCO has begun an engineering evaluation of their Type C test program to determine what changes can be made to prevent similar occurrences. It is anticipated that this review will be completed by March 31, 1985, based on their current work schedule forecasts.

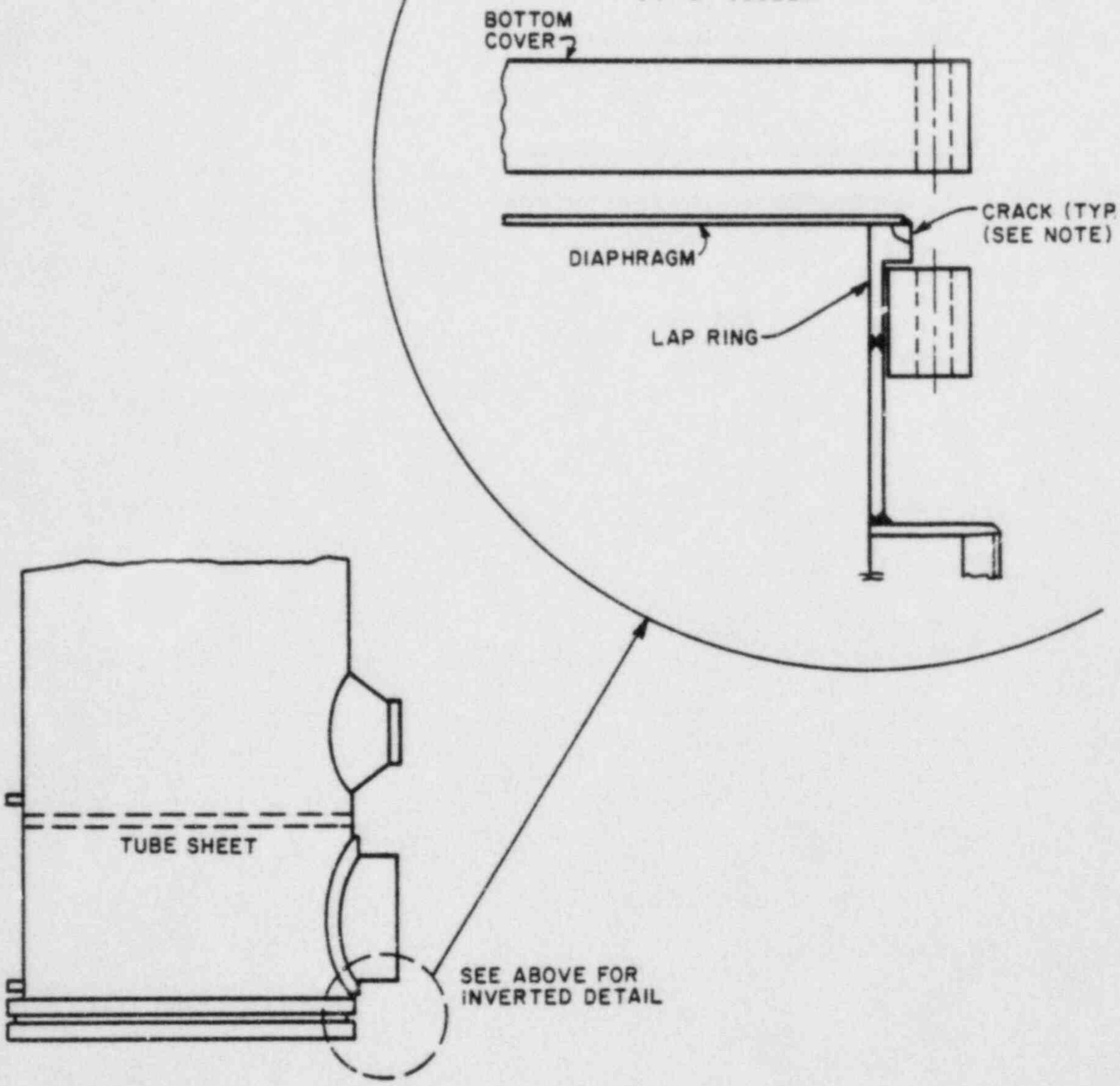
2.2 LOCAL LEAKAGE RATE TESTS (TYPES B AND C)

The Local Leakage Rate Tests (LLRTs) of containment isolation valves and primary containment penetrations were conducted as required by station surveillance procedures since the last Unit No. 1 Type A test performed in March 1981.

In accordance with Appendix J, 10CFR50, Paragraph V.B, data for the LLRTs are summarized in Section 4 of this report.

NOTE

RADIAL FLAWS WERE FOUND IN THE OUTER 5/8" REGION OF THE 1" THICK LAP RING. THE TYPE A LEAKAGE PATH WAS THROUGH THESE CRACKS AND THROUGH THE "D" COOLER DIAPHRAGM SURFACE FLAW. CRACKS WERE ON ALL THE COOLERS BUT MORE SEVERE ON "D" COOLER.



COOLER LOCATED INSIDE CONTAINMENT, INSTALLED IN VERTICAL POSITION

SERVICE WATER TUBE SIDE
RECIRCULATION SPRAY SHELL SIDE

ATTACHMENT 2.1A

RECIRCULATION SPRAY COOLER LAP RING ARRANGEMENT

NORTH ANNA POWER STATION-UNIT No. 1

SEPTEMBER 1984, CILRT

SECTION 3

TYPE A TEST

3.1 EDITED LOG OF EVENTS

This log was edited from the Official Log of Events.

3.1.1 August 1984 CILRT Edited Log of Events

August 4, 1984

1132 - Completed containment inspection. Reference 1-PT-61.1A for list of discrepancies.

1428 - Commenced pressurization. Initial pressure was 14.6 psia.

2219 - Air recirculation fan 1B tripped. Fans 1A and 1C are still running.

2357 - Secured pressurization.

August 5, 1984

0328 - Removed RTD (TE-LM100-4) from CILRT program on both Units No. 1 and 2 plant computers. This delayed temperature stabilization.

0600 - Satisfied temperature stablilzation.

1040 - Conducting preliminary leakage investigation on instrument air line. It was determined not to be significant.

1430 - Inspected purge lines using ultrasonic leak detector. No leakage observed.

1640 - Detected leakage through open (vented) test connection on Penetration 38.

1720 - Detected leakage through open (vented) test connection on Penetration 93.

1801 - Leakage on Penetration 93 determined to be in excess of 35 scfh.

1810 - The test connection on Penetration 93 was closed to isolate this leakage path.

1825 - Leakage on Penetration 38 determined to be approximately 65 percent of scale on NQC-4125. The test connection on penetration was closed to isolate this leakage path.

2322 - Personnel airlock pressure at 33.7 psig.

August 6, 1984

1211 - Personnel airlock pressure at 36.8 psig.

1535 - Personnel airlock pressurized to 42 psig to shorten the time to equalization.

1935 - Found leakage on LM test connection to the dry air cylinder. Valve tightened and leakage stopped. Inspected other valves and test connections. No significant leakage observed.

August 7, 1984

0030 - Closed test connection on penetration 38 was still leaking. Recapped 1-DA-07.

0444 - Recapped 1-DA-07. Installed a rubber stopper inside the cap to reduce leakage.

1010 - Investigated recirculation spray heat exchanger (RSHXs) lineup. The procedure called for these lines to be flooded.

1101 - Temporary pressure gages installed on service water side of RSHXs indicate 42 psig.

1300 - Flooded the service water piping on all four heat exchangers.

1735 - Installed pressure gages on service water supply header to the RSHXs. Readings were:

A - 86.8 psig
B - 86.8 psig
C - 87.5 psig
D - 82.0 psig

1958 - Due to increasing mass trend, bled the pressure on the service water supply header to 42 psig (less than containment pressure). Completed last at 2135.

August 8, 1984

0430 - Began preparations to pressurize service water return header to slightly less than containment pressure.

0545 - Service water return header pressure at 43.5 psig supply header at 60 psig.

1034 - Bled supply header pressure. Supply header pressure at 42 psig. Return header pressure at 43 psig.

1040 - Lost H Bus. This feeds the "A" Recirculation Fan motor. Component cooling water temperatures dropped approximately four degrees. These events affected temperature stabilization.

2058 - Started depressurization of containment.

August 9, 1984

1512 Containment at 14.774 psia.

1611 Conducted containment inspection. Noted water on bottom flange of the "D" RSHX.

2045 Chemistry analyzed water samples taken during containment walkdown.

August 10, 1984

0230 "As-found" Type C results for Penetration 38 are as follows:

TV-DA-100A 52.7 scfh
TV-DA-100B >257 scfh

1038 - Chemistry samples taken from "B" and "C" RSHX did not indicate significant presence of service water. Sample taken from "D" not sufficient for test.

1400 - Decision made to release Unit 1 containment so that remaining work can be completed. Type A to be performed after this work completed.

August 14, 1984

RSHX service water side was pressurized with air and doped with helium. Sniffed the recirculation spray side. No leakage detected.

August 18, 1984

0900 - Removed the bottom cover on the "D" RSHX. This was done to inspect the diaphram. A leakage path was suspected due to the change in the mass trend during service water header isolation attempts on August 7 and 8, 1984. A small crack was observed (water leaking through) on the diaphram.

Note: All four bottom diaphrams were replaced.

3.1.2 September 1984 CILRT Edited Log of Events

September 7, 1984

0739 - Commenced containment pressurization.

0910 - Returned RTD (TE-LM100-4) to the CILRT Program.

1510 - "B" Containment Air Recirculation Fan Motor tripped.

1625 - Secured pressurization at 59.584 psia.

1905 - Investigated leakage by MOV-HV-100B.

2158 - Temperature stabilization satisfied.

2159 - Determined that suspected leakage through MOV-HV-100B was fan noise (Purge and Exhaust fans were running).

<u>September 8, 1984</u>

0235 - Temporary pressure gauge on personnel airlock was removed as the fittings were leaking. Lineup was returned to normal.

1300 - Isolated Outside Recirculation spray pumps by closing MOV-RS-155A and B. This was to determine if leakage was from the Recirculation Spray System.

1500 - The pressure of the "B" outside Recirculation Spray Loop decreased.

<u>September 9, 1984</u>

0510 - Mechanical chiller tripped. The chiller cools the water circulating through the containment air recirculation fan coolers.

0528 - Chilled water pumps were airbound. Air is being vented off.

0705 - Installed pressure gages on each chilled water header (Penetrations 9, 10, and 11)

0743 - Penetration 11 pressure gage was increasing. This indicated that the "A" cooler system was leaking.

1039 - Performed leak-through test by placing rotometer on 1-CC-545. Leakage measured was 70 scfh.

1123 - Makeup test leakage test done on "B" Outside Recirculation Spray Pump Loop. Leakage measured was 6.8 scfh.

1135 - Makeup test was done on "A" Outside Recirculation Spray Pump Loop. Leakage measured was 4.2 scfh.

1140 - Opened both suction valves MOV-RS-155A and B to restore the original valve lineup for the Outside Recirculation Spray Systems.

1310 - Determined that the Type A test could not be completed without the chilled water system running.

1430 - Established flow of approximately 500 gpm through "B" and "C" coolers.

1438 - Chilled water flow stopped since there is air in the lines.

1506 - Reestablished flow on the "B" and "C" coolers.

1529 - Started mechanical chiller.

1800 - Determined that containment temperature was stable enough to start the ILRT.

September 10, 1984

1800 - Completed 24 hour run with final UCL of 0.029558%/day.

1831 - Started superimposed flow.

1858 - Superimposed flow stopped due to HP misunderstanding.

1920 - Restarted superimposed flow.

2340 - Completed superimposed leak verification test.

September 11, 1984

0101 - Commenced containment depressurization.

1350 - Containment at 14.534 psia.

3.2 GENERAL TEST DESCRIPTION

3.2.1 Initial Conditions

In accordance with the North Anna Unit No. 1 CILRT Procedure 1-PT-61.1 (Reference 2), the following is a partial listing of the initial conditions completed and documented prior to containment pressurization:

a. General inspection of the accessible interior and exterior surfaces of the containment structure was performed.

b. All test instrumentation calibrated or functionally verified within six months of the test.

c. All required system valve lineups completed.

d. Containment air recirculation system operating to maintain stable conditions.

e. Plant computers were operational and programmed for the CILRT.

f. The official Log of Events was established.

g. Site meteorological data was recorded during the performance of the test.

h. All required Types B and C leakage testing complete or reviewed by the Test Director.

3.2.2 Equipment and Instrumentation

Pressurization of the containment was achieved by the utilization of ten air compressors. Compressed air was piped through two aftercoolers in parallel and then through a refrigerant air dryer. Adequate instrumentation and valving were installed to maintain control of the compressed air quality throughout the pressurization sequence. The total capacity of the pressurization system was slightly in excess of 10,000 cubic feet per minute.

The various containment parameters were monitored by the Leakage Monitoring System instrumentation. The instrumentation (Attachment 3.2A), consisted of multiple resistance temperature detectors (RTDs), moisture dectectors, and two absolute pressure quartz manometers. The general locations of the temperature and moisture sensors are shown in Attachments 3.2B and 3.2C.

A pair of rotometers were used to perform the superimposed leakage verification test. With the exception of these rotometers, all test instrumentation was monitored by the plant computer.

3.2.3 Data Acquisition System

The data acquisition system used for the North Anna Unit No. 1 CILRT was the Westinghouse Prodac P250 process plant computer.

For the CILRT, the P250 monitored the following instrumentation:

Type	Scan Rate (sec)
18 RTDs	32
5 moisture detectors	32
2 quartz manometers	2

The input to the CILRT program was a P250 calculated 10-minute average. During the August 1984 CILRT, it was noted that the CILRT program was not always running at 10 minute intervals. The P250 10-minute average program was determining 10-minutes by counting the number of accumulated scans that should have been collected. For example, a 2-second scan should have 300 scans accumulated. The time skewing was random in nature. This was attributed to the variable system demand. For the September 1984 CILRT, the P250 average program was modified to force an average at 10 minutes, even if the scan counter had not accumulated all of its scans.

The CILRT program performs sensor validity checks on the temperature, moisture, and pressure sensors to identify any aberrant behavior. If all sensors are trending within their CILRT program limits, the program calculates weighted average dewpoint temperature, vapor pressure, weighted average containment temperature, and containment air mass.

Instantaneous values of the CILRT instruments were recorded every 5 minutes during the test period, using the P250 digital trend function on the operator's console.

During the August 1984 CILRT, the RTD sensitivity was determined to be causing some data scatter. A three-fold improvement in the RTD sensitivity was realized by changing the range of the computer bridge circuit. This improvement was in place for the September 1984 CILRT.

3.2.4 Data Resolution System

Once the P250 has acquired the appropriate data, the reduced parameters are manually input into Vepco's Richmond Computer System for leakage rate calculations. For the North Anna Unit No. 1 CILRT, the Absolute Method of Mass Point Analysis was used to determine the leakage rate.

Absolute Method of Mass Point Analysis

This method consists of calculating air masses within the containment structure over the test period from pressure, temperature, and dewpoint observations. The air masses are computed using the ideal gas law as follows:

$$\text{Mass} = \frac{144V\ (P-Pv)}{RT} \qquad \text{(Eq.1)}$$

Where:

M = air mass, lbm
P = total pressure, psia
Pv = vapor pressure, psia
R = 53.35 ft-lbf/lbm°R (for air)
T = average containment temperature, °R
V = containment free volume, 1.825×10^6 ft^3

The leakage rate is then determined by plotting the air mass as a function of time, using a least-squares fit to determine the slope, A = dm/dt. The leakage rate is expressed as a percentage of air mass lost in 24 hours or symbolically:

$$\text{Leakage rate} = (A/B)\ (-2400) \qquad \text{(Eq. 2)}$$

Where A is the slope of the least-squares curve and B is the y intercept, the sign convention is such that the leakage out of containment is positive and the units are in percent/day.

A 95-percent confidence interval is calculated using a Student's t distribution. The sum of the leakage rate and the 95-percent confidence interval is the UCL.

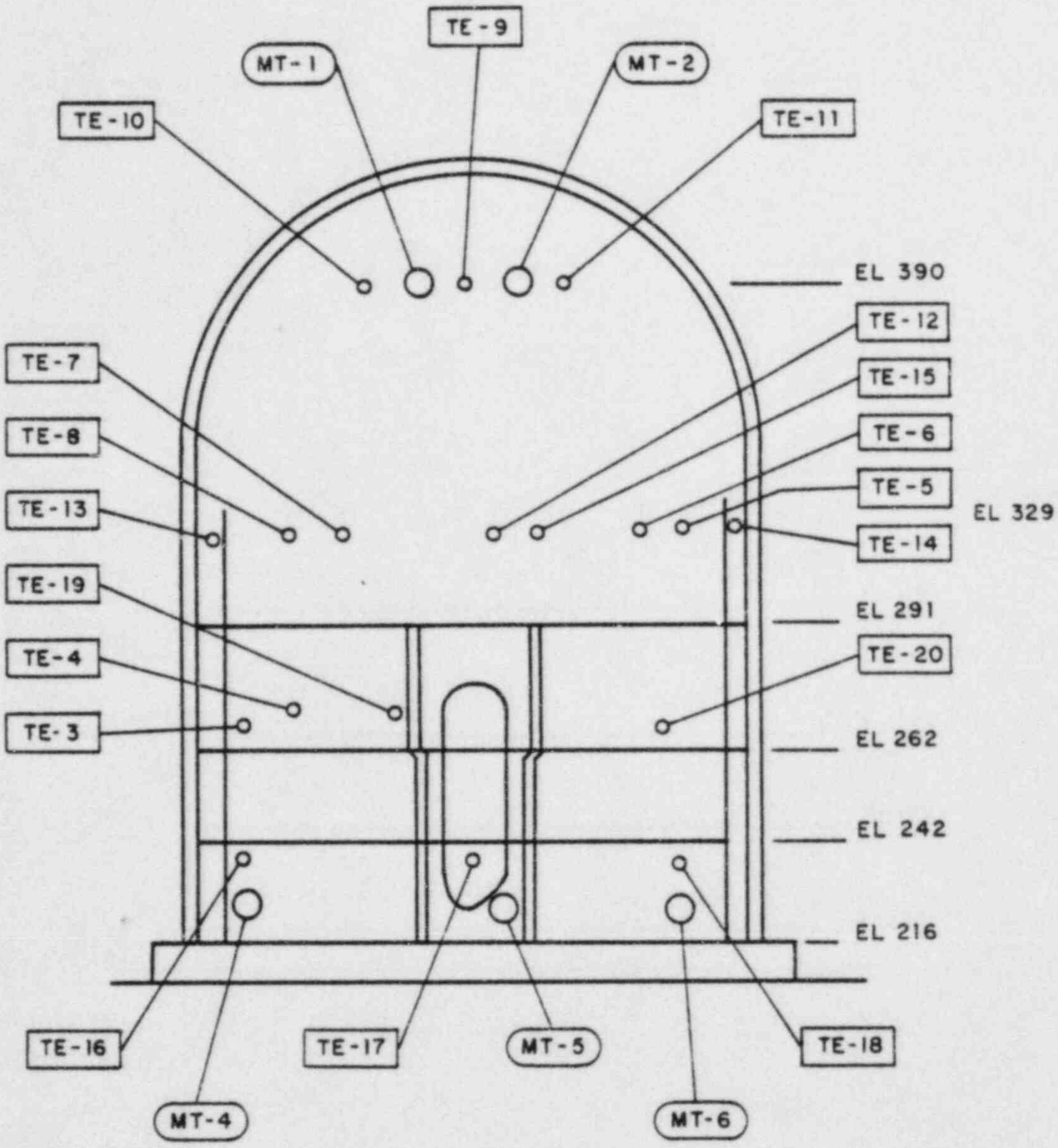
ATTACHMENT 3.2A

INSTRUMENTATION

Instrument	Weight Factor	Computer Point	Range(1)	Zone(2)	Accuracy
TE-LM-100-3	0.06785	T1002A	0-200°F	A	± 0.1°F
TE-LM-100-4	0.07513	T1003A	0-200°F	B	± 0.1°F
TE-LM-100-5	0.04846	T1004A	0-200°F	C	± 0.1°F
TE-LM-100-6	0.04846	T1005A	0-200°F	C	± 0.1°F
TE-LM-100-7	0.04846	T1006A	0-200°F	E	± 0.1°F
TE-LM-100-8	0.04846	T1007A	0-200°F	E	± 0.1°F
TE-LM-100-9	0.09604	T1008A	0-200°F	F	± 0.1°F
TE-LM-100-10	0.09604	T1009A	0-200°F	F	± 0.1°F
TE-LM-100-11	0.09604	T1010A	0-200°F	F	± 0.1°F
TE-LM-100-12	0.02256	T1011A	0-200°F	G	± 0.1°F
TE-LM-100-13	0.02256	T1012A	0-200°F	H	± 0.1°F
TE-LM-100-14	0.02256	T1013A	0-200°F	G	± 0.1°F
TE-LM-100-15	0.02256	T1014A	0-200°F	H	± 0.1°F
TE-LM-100-16	0.04972	T1015A	0-200°F	D	± 0.1°F
TE-LM-100-17	0.04972	T1016A	0-200°F	D	± 0.1°F
TE-LM-100-18	0.04972	T1017A	0-200°F	D	± 0.1°F
TE-LM-100-19	0.06785	T1036A	0-200°F	A	± 0.1°F
TE-LM-100-20	0.06785	T1040A	0-200°F	B	± 0.1°F
MT-LM-100-1	0.12569	Y2020A	32-110°F	I	± 0.5°F
MT-LM-100-2	0.12569	T1042A	32-110°F	I	± 0.5°F
MT-LM-100-4	0.24954	T1044A	32-110°F	J	± 0.5°F
MT-LM-100-5	0.24954	T1045A	32-110°F	J	± 0.5°F
MT-LM-100-6	0.24954	T1041A	32-110°F	J	± 0.5°F
PIT-LM-102	--	U2173	0-100 psia	-	± 0.02 psia
PIT-LM-107	--	U2174	0-100 psia	-	± 0.02 psia

NOTES

(1) RTD ranges changed to 60-120°F for September 1984 CILRT.
(2) Zone used for sensor validity checking purposes only.



PROFILE VIEW

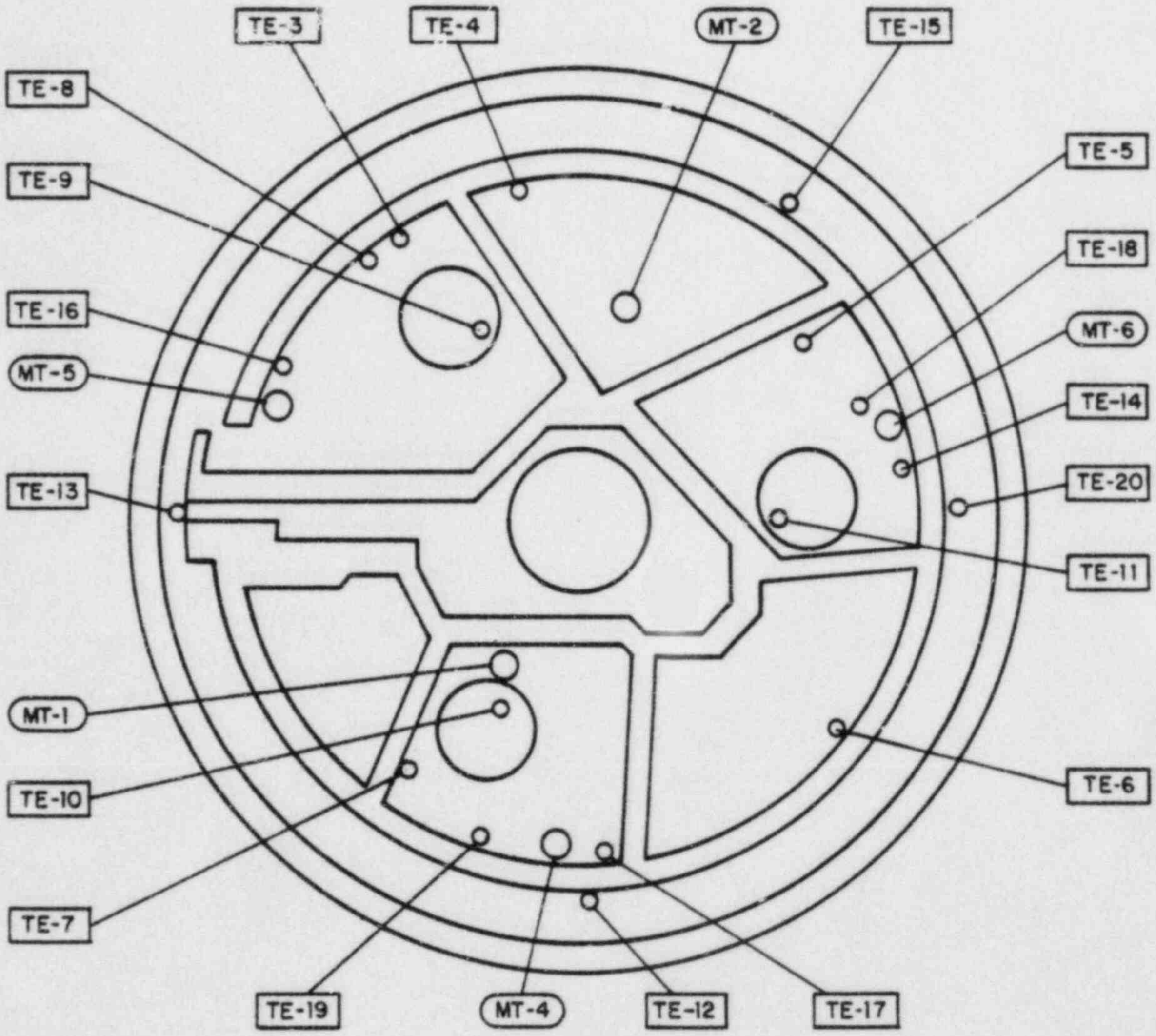
NOTES:

1. TE = TE-LM-100-3 (TYP)
2. TE = 1, 2 NOT USED
3. MT = MT-LM-100-1 (TYP)
4. MT-3 NOT USED

ATTACHMENT 3.2B

INSTRUMENTATION LOCATION
TEMPERATURE & MOISTURE
DETECTORS

NORTH ANNA POWER STATION-UNIT No.1
SEPTEMBER 1984, CILRT



PLAN VIEW

ATTACHMENT 3.2C
INSTRUMENT LOCATION
TEMPERATURE & MOISTURE
DETECTORS
NORTH ANNA POWER STATION-UNIT No. 1
SEPTEMBER 1984, CILRT

3.3 TEST RESULTS

3.3.1 Presentation of Test Results

The test data for the September 1984 CILRT test is based on a 24-hour period starting at 18:00 hours on September 9, 1984. The final test results were determined by VEPCO's Richmond CILRT computer program. The reduced input data, test results, and representative graphs are contained in Attachments 3.3A through 3.3 F.

The Absolute Method - Mass Point Analysis test results satisfy the procedural acceptance criteria of 0.075 percent/day.

The Type A test instrumentation was verified by the superimposed leakage test method. This method was required by the NRC. The results were acceptable, as shown in Section 3.3.2.2.

3.3.2 CILRT Results

The CILRT was conducted in accordance with the North Anna 1-PT-61.1 surveillance test procedure. The results for the CILRT and for the superimposed leakage test are shown below.

3.3.2.1 Mass Point Analysis Results

Item	(Percent/day)
1. Leakage rate	0.027867
2. Confidence level	0.001691
3. Type C leakage penalty	0.003072
4. Total	0.032630

3.3.2.2 Superimposed Leakage Test Results

The superimposed leakage path exhausted to the station process vent system. Changes in the process vent system pressure caused a change in the superimposed leakage value that was desired for the test. The exact time the change in the back pressure occurred is not known. The time the change was found is the time that is used in the following calculations.

1. Calculate superimposed leakage, Lo

   A. Corrected flow for 150 cfh at 41 psig for period 19.667 to 22:250 hours on September 10, 1984.

   $$Lo_1 = 150 \left(\frac{41. + 14.696}{14.696}\right)^{\frac{1}{2}} = 292.01 \text{ scfh}$$

   Note: Change in process vent backpressure occurred prior to 22:250 hours.

   B Corrected flow for 129 cfh at 41.5 psig for period 2225.0 to 2366.7 hours on September 10, 1984.

$$Lo_2 = 129 \left(\frac{41.5 + 14.696}{14.696}\right)^{\frac{1}{2}} = 252.25 \text{ scfh}$$

C. Calculate average flow

i. 292.01 scfh x 2.583 hours = 754.26 scf
ii. 252.25 scfh x 1.417 hours = 357.44 scf
iii. Average flow in 4 hours = 277.93 scfh

D. Lo, in percent/day

i. $$\frac{277.93 \text{ scfh}}{286.12 \text{ scfh}} = \frac{x}{0.1 \frac{\%}{day}}$$

or Lo = 0.097138 %/day

E. Composite Leakage, Lc

i. Lc = 0.109325 %/day

F. Leakage rate from 24 hour CILRT, L_{am}

i. L_{am} = 0.027867 %/day

G. $L_{am} + L_o \pm .25L_a$

i. 0.027867 + 0.097138 + 0.025 = 0.150005

ii. 0.027867 + 0.097138 - 0.025 = 0.100005

$0.100005 < 0.109325 < 0.150005$

The composite flow is within the limits even when using a higher than actual superimposed flow for the period 19:667 to 22:250 hours on September 10, 1984.

3.3.2.3 Types B and C Penetration Leakage

Types B and C Penetration Leakage are to be added since these penetrations were not vented and drained.

The leakage assigned is the Types B and C recorded value (maximum pathway analysis) when only minimum pathway analysis is required.

Penetration No.	Leakage (scfh)
8	0.28
9	4.5
11	0.18
18	0.35
26	0.49
39	1.58
40	0.85
41	0.35
56B	0.21

Total 8.79 scfh or 0.003072 %/day

$$\frac{8.79}{286.12} = \frac{X}{0.1} \quad X = 0.003072$$

CONTAINMENT INTEGRATED LEAKAGE RATE TEST
FROM 1800 HOURS ON 9/9/84 to 1800 HOURS ON 9/10/84

INPUT VARIABLES

Time (hr)	Absolute Pressure (psia)	Vapor Pressure (psia)	Absolute Temperature (°R)	Dewpoint (°F)
0.0	58.634	0.1929	532.42	52.18
0.333	58.625	0.1921	532.32	52.06
0.666	58.616	0.1909	532.26	51.89
1.000	58.609	0.1903	532.21	51.81
1.333	58.602	0.1895	532.15	51.70
1.666	58.597	0.1890	532.10	51.62
2.0	58.593	0.1888	532.07	51.59
2.333	58.589	0.1885	532.03	51.55
2.666	58.585	0.1889	532.01	51.61
3.0	58.579	0.1886	531.97	51.56
3.333	58.575	0.1879	531.92	51.46
3.666	58.571	0.1877	531.89	51.43
4.0	58.567	0.1869	531.85	51.32
4.333	58.563	0.1872	531.83	51.36
4.666	58.559	0.1862	531.80	51.22
5.0	58.555	0.1860	531.78	51.19
5.333	58.552	0.1854	531.74	51.10
5.666	58.548	0.1854	531.71	51.11
6.0	58.545	0.1852	531.69	51.08
6.333	58.542	0.1848	531.67	51.01
6.666	58.539	0.1843	531.64	50.95
7.0	58.536	0.1843	531.63	50.95
7.333	58.534	0.1841	531.60	50.92
7.666	58.531	0.1841	531.57	50.91
8.0	58.528	0.1837	531.56	50.86
8.333	58.526	0.1837	531.55	50.86
8.666	58.523	0.1837	531.53	50.85
9.0	58.521	0.1834	531.51	50.81
9.333	58.518	0.1831	531.50	50.76
9.666	58.516	0.1832	531.49	50.78
10.0	58.514	0.1831	531.47	50.76
10.333	58.512	0.1826	531.45	50.69
10.666	58.510	0.1823	531.44	50.65
11.0	58.507	0.1824	531.42	50.67
11.333	58.505	0.1822	531.40	50.64
11.666	58.503	0.1820	531.39	50.60
12.0	58.500	0.1815	531.37	50.53

Time (hr)	Pressure (psia)	Absolute Pressure (psia)	Vapor Temperature (°R)	Absolute Dewpoint (°F)
12.333	58.498	0.1814	531.35	50.52
12.666	58.495	0.1811	531.34	50.47
13.0	58.493	0.1814	531.33	50.52
13.333	58.491	0.1809	531.30	50.44
13.666	58.489	0.1806	531.28	50.39
14.0	58.486	0.1806	531.28	50.39
14.333	58.484	0.1805	531.26	50.38
14.666	58.482	0.1799	531.24	50.29
15.0	58.479	0.1797	531.21	50.26
15.333	58.478	0.1795	531.19	50.23
15.666	58.475	0.1800	531.19	50.31
16.0	58.474	0.1792	531.16	50.18
16.333	58.471	0.1796	531.15	50.24
16.666	58.470	0.1796	531.14	50.24
17.0	58.468	0.1794	531.12	50.21
17.333	58.467	0.1795	531.12	50.23
17.667	58.465	0.1797	531.11	50.26
18.0	58.464	0.1799	531.08	50.29
18.333	58.463	0.1796	531.09	50.24
18.666	58.461	0.1794	531.08	50.21
19.0	58.460	0.1796	531.07	50.25
19.333	58.458	0.1795	531.05	50.23
19.666	58.457	0.1790	531.04	50.16
20.0	58.456	0.1790	531.02	50.16
20.333	58.454	0.1790	531.02	50.15
20.666	58.452	0.1788	531.00	50.13
21.0	58.451	0.1792	530.99	50.18
21.333	58.450	0.1792	530.97	50.18
21.666	58.449	0.1790	530.96	50.16
22.0	58.447	0.1793	530.95	50.20
22.333	58.446	0.1787	530.93	50.11
22.666	58.444	0.1791	530.92	50.17
23.0	58.443	0.1792	530.91	50.18
23.333	58.441	0.1788	530.91	50.13
23.666	58.440	0.1790	530.89	50.15
24.0	58.438	0.1790	530.85	50.16

ATTACHMENT 3.3B

CONTAINMENT INTEGRATED LEAKAGE RATE TEST
FROM 1800 HOURS ON 9/9/84 to 1800 HOURS ON 9/10/84

ABSOLUTE TEST METHOD, MASS POINT ANALYSIS

Time (hr)	Mass (lbm)	Leakage (pct/day)	Conf (pct/day)	UCL (pct.day)
0.000	540698.03	0.000000	0.000000	0.000000
0.333	540724.20	0.000000	0.000000	0.000000
0.667	540712.98	0.099500	0.030528	0.630528
1.000	540704.20	0.009669	0.236953	0.227284
1.333	540707.50	0.001420	0.113155	0.114575
1.667	540717.20	0.014064	0.069887	0.055822
2.000	540712.60	0.011515	0.046797	0.035282
2.333	540718.80	0.016373	0.034064	0.017691
2.667	540698.21	0.000724	0.031802	0.032526
3.000	540686.54	0.017867	0.030961	0.048828
3.333	540706.76	0.014165	0.025223	0.039388
3.667	540702.14	0.013850	0.020751	0.034601
4.000	540712.82	0.008516	0.018235	0.026751
4.333	540693.54	0.012255	0.015967	0.028222
4.667	540695.95	0.013577	0.013806	0.027383
5.000	540681.15	0.018510	0.013013	0.031524
5.333	540699.76	0.016673	0.011573	0.028247
5.667	540692.57	0.016770	0.010242	0.027012
6.000	540687.03	0.017741	0.009180	0.026921
6.333	540684.01	0.018768	0.008297	0.027066
6.667	540690.53	0.018158	0.007509	0.025667
7.000	540672.90	0.020268	0.007124	0.027392
7.333	540686.78	0.019644	0.006518	0.026162
7.667	540690.13	0.018522	0.006065	0.024586
8.000	540675.66	0.019256	0.005615	0.024871
8.333	540667.29	0.020620	0.005346	0.025966
8.667	540660.46	0.022261	0.005200	0.027461
9.000	540664.80	0.022983	0.004874	0.027857
9.333	540650.31	0.024738	0.004849	0.029586
9.667	540640.69	0.026831	0.004965	0.031796
10.000	540643.76	0.028135	0.004812	0.032948
10.333	540649.97	0.028580	0.004528	0.033108
10.667	540644.11	0.029213	0.004294	0.033507
11.000	540635.39	0.030179	0.004146	0.034325
11.333	540639.08	0.030610	0.003928	0.034538
11.667	540633.22	0.031187	0.003749	0.034936
12.000	540630.14	0.031718	0.003581	0.035299
12.333	540632.57	0.031909	0.003395	0.035305
12.667	540618.05	0.032694	0.003308	0.036002
13.000	540606.57	0.033806	0.003322	0.037128
13.333	540623.54	0.033858	0.003159	0.037017
13.667	540628.46	0.033573	0.003019	0.036592

ATTACHMENT 3.3B (Cont)

Time (hr)	Mass (lbm)	Leakage (pct/day)	Conf (pct/day)	UCL (pct.day)
14.000	540600.64	0.034394	0.002986	0.037380
14.333	540603.07	0.034906	0.002891	0.037797
14.667	540610.47	0.034966	0.002762	0.037728
15.000	540615.04	0.034752	0.002649	0.037401
15.333	540627.98	0.034014	0.002634	0.036648
15.667	540595.20	0.034391	0.002549	0.036940
16.000	540624.51	0.033684	0.002539	0.036223
16.333	540603.15	0.033648	0.002436	0.036084
16.667	540604.06	0.033513	0.002343	0.035856
17.000	540607.72	0.033214	0.002271	0.035485
17.333	540597.21	0.033171	0.002185	0.035356
17.667	540586.98	0.033341	0.002110	0.035450
18.000	540606.38	0.032924	0.002072	0.034996
18.333	540590.03	0.032889	0.001997	0.034896
18.667	540583.51	0.032973	0.001928	0.034901
19.000	540581.94	0.033019	0.001861	0.034881
19.333	540584.98	0.032936	0.001799	0.034736
19.667	540590.22	0.032693	0.001755	0.034448
20.000	540601.30	0.032187	0.001766	0.033953
20.333	540583.36	0.032046	0.001714	0.033759
20.667	540586.41	0.031809	0.001675	0.033484
21.000	540584.22	0.031591	0.001635	0.033226
21.333	540595.31	0.031141	0.001643	0.033784
21.667	540597.45	0.030650	0.001662	0.032312
22.000	540586.60	0.030351	0.001637	0.031989
22.333	540603.25	0.029756	0.001689	0.031446
22.667	540591.17	0.029374	0.001681	0.031055
23.000	540591.45	0.028984	0.001675	0.030659
23.333	540575.99	0.028834	0.001634	0.030468
23.667	540585.84	0.028513	0.001618	0.030131
24.000	540607.39	0.027867	0.001692	0.029559

ATTACHMENT 3.3C

SUPERIMPOSED LEAKAGE RATE TEST
FROM 1940 HOURS ON 9/10/84 TO 2340 ON 9/10/84

INPUT VARIABLES

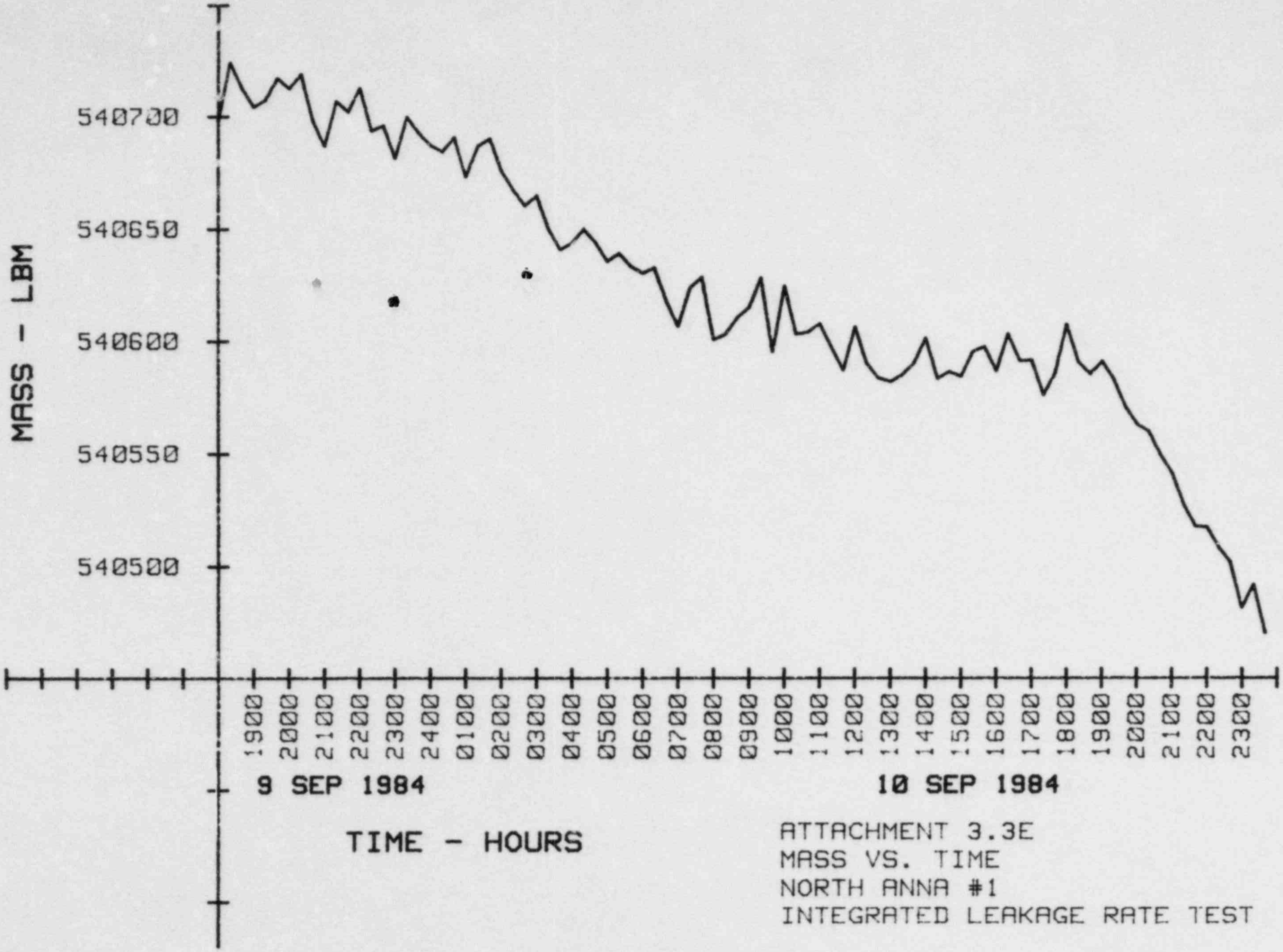
Time (hr)	Absolute Temperature (°R)	Dewpoint (°F)	Absolute Pressure
0.0	530.81	50.060	58.429
0.333	530.80	50.050	58.427
0.666	530.78	49.980	58.424
1.0	530.77	50.010	58.422
1.333	530.76	50.010	58.420
1.666	530.75	50.100	58.418
2.0	530.74	50.120	58.416
2.333	530.73	49.990	58.414
2.666	530.72	50.000	58.412
3.0	530.71	49.970	58.410
3.333	530.71	50.000	58.408
3.666	530.67	49.890	58.404
4.0	530.65	49.820	58.399

ATTACHMENT 3.3D

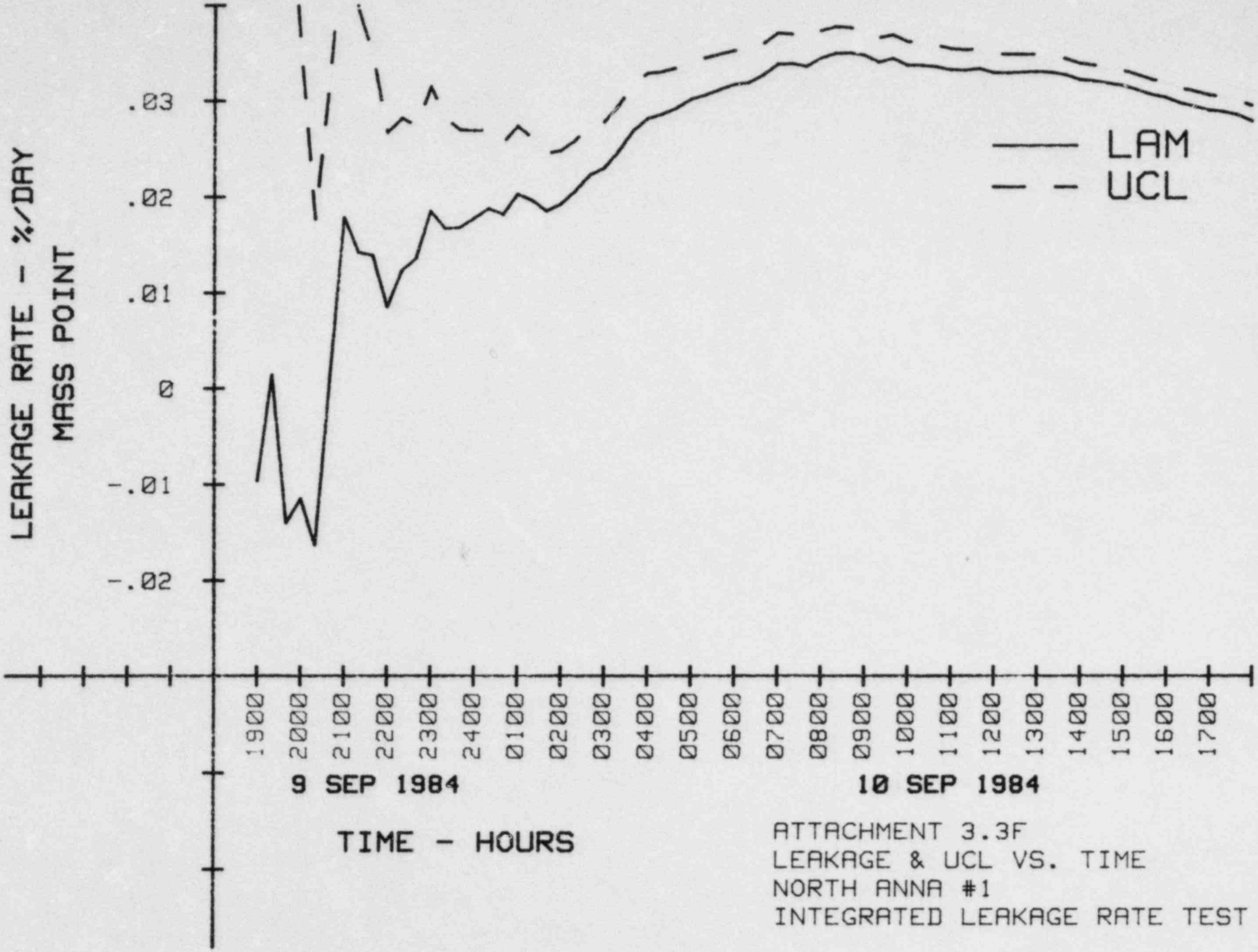
SUPERIMPOSED LEAKAGE RATE TEST
FROM 1940 HOURS ON 9/10/84 to 2340 HOURS ON 9/10/84

ABSOLUTE TEST METHOD, MASS POINT ANALYSIS

Time (hr)	Mass (lbm)	Leakage (pct/day)	Conf (pct/day)	UCL (pct.day)
0.000	540570.78	0.000000	0.000000	0.000000
0.333	540563.02	0.000000	0.000000	0.000000
0.667	540559.85	0.072787	0.089661	0.162448
1.000	540549.63	0.088732	0.034792	0.123525
1.333	540541.25	0.096491	0.019548	0.116040
1.667	540527.33	0.111409	0.021744	0.133153
2.000	540517.72	0.118516	0.016723	0.135240
2.333	540517.35	0.112016	0.014058	0.126074
2.667	540508.35	0.109501	0.010965	0.120466
3.000	540501.82	0.106996	0.008995	0.115991
3.333	540481.41	0.113120	0.009717	0.122837
3.667	540491.77	0.106997	0.010245	0.117241
4.000	540470.01	0.109323	0.008911	0.118234



ATTACHMENT 3.3E
MASS VS. TIME
NORTH ANNA #1
INTEGRATED LEAKAGE RATE TEST



ATTACHMENT 3.3F
LEAKAGE & UCL VS. TIME
NORTH ANNA #1
INTEGRATED LEAKAGE RATE TEST

SECTION 4

LOCAL LEAKAGE RATE TESTS (TYPES B AND C)

Section 4 contains the LLRT data performed since the March 1981 Type A Test. The data contained in this section is summarized below:

Attachment 4A 1984 LLRT Data (Refueling Outage)
Attachment 4B 1983 LLRT Data
Attachment 4C 1982 LLRT Data (Refueling Outage)
Attachment 4D 1981 LLRT Data

The combined "as-left" leakage rate for all the valves and penetrations is well below the acceptance criteria of less than $0.60L_A$. Reference the applicable surveillance procedures for the actual totals.

ATTACHMENT 4A

1984 LOCAL LEAKAGE RATE TEST PENETRATION DATA

Penetration		Type Test	Equipment/Valves Tested	Prerepair Leakage (scfh)	Postrepair Leakage (scfh)	Repair/Notes
1	Component Cooling	C	TC-CC-103B	0	0	
2	Component Cooling	C	1-CC-193	0	0	
4	Component Cooling	C	TV-CC-198	0	0	
5	Component Cooling	C	TV-CC-103A	0	0	
7B	Safety Injection	C	1-SI-79	0.35	0.35	
			MOV-1867C	0	0	
			MOV-1867D	See Repair	0	Found MOV-1867D motor inoperable. Replaced motor.
8	Component Cooling	C	TV-CC-101A	0.28	0.28	
			TV-CC-101B	0.28	0.28	
9	Air Recirculation Cooling Water	C	1-CC-572	>35	4.5	WR051762
10	Air Recirculation Cooling Water	C	1-CC-559	0	0	
11	Air Recirculation Cooling Water	C	1-CC-546	>35	0.18	WR051760

1984 LOCAL LEAKAGE RATE TEST PENETRATION DATA

Penetration		Type Test	Equipment/Valves Tested	Prerepair Leakage (scfh)	Postrepair Leakage (scfh)	Repair/Notes
12B	Air Recirculation Cooling	C	TV-CC-100B	0	0	
			TV-CC-105B	0	0	
13B	Air Recirculation Cooling Water	C	TV-CC-100C	0	0	
			TV-CC-105C	0	0	
14B	Air Recirculation Cooling Water	C	TV-CC-100A	0		
			TV-CC-105A	4.6		WR051761 WR014343
15	Charging	C	1-CH-322	0	0	
			MOV-1289A	0	0	
16	Component Cooling	C	1-CC-154	>35	0	WR
			TV-CC-104C	0	0	
17	Component Cooling	C	1-CC-119	>35	0	WR
			TV-CC-104B	0	0	
18	Component Cooling	C	1-CC-84	0.35	0.35	
			TV-CC-104A	0	0	
19B	RCP Seal Water	C	1-CH-402	0	0	
			MOV-1380	0	0.28	WR Adjusted torque switch
			MOV-1381	0	0	
20	Safety Injection	C	1-SI-110	0	0	
			1-SI-58	0	0	
22	Safety Injection	C	1-SI-185	0	0	
			MOV-1836	0	0	

1984 LOCAL LEAKAGE RATE TEST PENETRATION DATA

Penetration		Type Test	Equipment/Valves Tested	Prerepair Leakage (scfh)	Postrepair Leakage (scfh)	Repair/Notes
24B	RHR	C	1-RH-36	0	0	
			1-RH-37	2.38	2.38	
25	Component Cooling	C	TV-CC-102E	0	0	
			TV-CC-102F	0	0	
26	Component Cooling	C	TV-CC-102A	0.17	0.17	
			TV-CC-102B	0.49	0.49	
27	Component Cooling	C	TV-CC-102C	0	0	
			TV-CC-102D	0	0	
28B	Letdown	C	RV-1203	2.1	0	WR027243
			HCV-1200A,B,C	>35	10.85	WR051769 WR051768 WR051766
			HCV-1142	0	0	
			TV-1204	0	0	
31	Containment Atmosphere Cleanup	C	1-HC-14	>35	2.45	WR051782
			TV-HC-105A	3.5	0.4 Combination	WR051781
			TV-HC-105B	0.87		WR051780
			TV-HC-101A,B	0	0	
32	Wet Layup	C	1-WT-468	2.1	0	WR051771
			1-WT-465	0	0	
33	Primary Drains	C	TV-DG-100A	0	0	
			TV-DG-100B	0	0	

1984 LOCAL LEAKAGE RATE TEST PENETRATION DATA

Penetration		Type Test	Equipment/Valves Tested	Prerepair Leakage (scfh)	Postrepair Leakage (scfh)	Repair/Notes
34	Fire Protection	C	1-FP-275	0	0	
			1-FP-274	0	0	
38	Containment Sump Pump Discharge	C	TV-DA-100A	0.25	4.2	
			TV-DA-100B	0.3	11.2	
39	Blowdown	C	TV-BD-100A	1.5	1.5	
			TV-BD-100B	1.58	1.58	
40	Blowdown	C	TV-BD-100E	5.59	0	WR051764
			TV-BD-100F	0.85	0.85	
41	Blowdown	C	TV-BD-100C	0.35	0.35	
			TV-BD-100D	0.35	0.35	
42	Service Air	C	1-SA-2	0	0	
			1-SA-29	0.5	0.5	
43	Air Sample	C	1-IA-149			
			TV-RM-100D			
			TV-RM-100A			
44	Air Sample	C	TV-RM-100B	0	0	
			TV-RM-100C	0	0	
45	PG Water	C	1-RC-149	0	0	
			TV-1519A	0	0	
46B	Loopfill	C	1-CH-330	>35	0	WR05177[illegible]
			FCV-1160	>35	0.175	WR05177[illegible]

1984 LOCAL LEAKAGE RATE TEST PENETRATION DATA

Penetration		Type Test	Equipment/Valves Tested	Prerepair Leakage (scfh)	Postrepair Leakage (scfh)	Repair/Notes
47	Instrument Air	C	1-IA-55	0.4	0.4	
			TV-IA-102A	0	0	
			TV-IA-102B	0	0	
48	Primary Vent Header	C	TV-VG-100A	0	0	
			TV-VG-100B	0	0	
50	Safety Injection	C	HCV-1936	0	0	
			TV-S1-101	0	0	
53	Safety Injection	C	1-SI-106	0	0.93	WR051788
			TV-SI-100	0	0	
54	Primary Vent	C	1-DA-39	0	0	
			1-DA-41	0	0	
55B	Leakage Monitoring	C	TV-LM-100E	0	0	
			TV-LM-100F	0	0	
56A	Sample System	C	TV-SS-102A	0	0	
			TV-SS-102B	0	0	
56B	Sample System	C	TV-SS-106A	0.07	0.07	
			TV-SS-106B	0.21	0.21	
56C	Sample System	C	TV-SS-100A	0	0	
			TV-SS-100B	0	0	
56D	Sample System	C	TV-SS-112A	0	0	
			TV-SS-112B	0	0	
57A	Sample System	C	TV-SS-104A	0	0	Changed penetration number from 55A
			TV-SS-104B	0	0	

ATTACHMENT 4A (Cont)

1984 LOCAL LEAKAGE RATE TEST PENETRATION DATA

Penetration		Type Test	Equipment/Valves Tested	Prerepair Leakage (scfh)	Postrepair Leakage (scfh)	Repair/Notes
57B	Leakage Monitoring	C	TV-LM-100G	0	0	Changed penetration number from 57A
			TV-LM-100H	0	0	
57C	Sample System	C	TV-SS-101B	0	0	Changed penetration number from 57C
			TV-SS-101A	0	0	
60B	Safety Injection	C	1-SI-207	0	0	
			MOV-1890B	0.70	0.70	
61B	Safety Injection	C	1-SI-206	0	0	
			MOV-1890A	0	0	
62	Safety Injection	C	MOV-1890C	0	0	
			MOV-1890D	0	0	
			1-SI-197	0	0	
			1-SI-199	0	0	
			1-SI-195	0	0	
63	Quench Spray	C	MOV-QS-101B	0	0	
			1-QS-19	0	0	
64	Quench Spray	C	MOV-QS-101A	0	0	
			1-QS-11	0	0	
66B	Recirculation Spray	C	MOV-RS-100A	0.6	0.6	
			MOV-RS-101A	22	11.2	WR051792 WR Adjusted torque switch
67B	Recirculation Spray	C	MOV-RS-100B	0	0	
			MOV-RS-101B	0	0	

1984 LOCAL LEAKAGE RATE TEST PENETRATION DATA

Penetration		Type Test	Equipment/Valves Tested	Prerepair Leakage (scfh)	Postrepair Leakage (scfh)	Repair/Notes
70	Recirculation Spray	C	MOV-RS-156B	0	0	
			1-RS-27	0	0	
71	Recirculation Spray	C	MOV-RS-156A	9.2	5.9	WR012196 Adjusted torque switch
			1-RS-18	0	0	
79	Service Water	C	MOV-SW-103D	>35	1.61	WR11656
80	Service Water	C	MOV-SW-103C	7.34	7.34	
81	Service Water	C	MOV-SW-103B	8.04	8.04	
82	Service Water	C	MOV-SW-103A	0	0	
83	Service Water	C	MOV-SW-104D	0.42	0	WR
84	Service Water	C	MOV-SW-104C	1.89	1.89	
85	Service Water	C	MOV-SW-104B	0	0	
86	Service Water	C	MOV-SW-104A	0	0	
89	Air Ejector	C	1-VP-12	3.5	0.7	WR048279
			TV-SV-102-1	0	0	
			TV-SV-103	1.93	1.93	
90	Purge	C	MOV-HV-100C	>35 Combination	5.00 Combination	WR048210
			MOV-HV-100D			WR048211
			MOV-HV-101			

1984 LOCAL LEAKAGE RATE TEST PENETRATION DATA

Penetration		Type Test	Equipment/Valves Tested	Prerepair Leakage (scfh)	Postrepair Leakage (scfh)	Repair/Notes
91	Purge	C	MOV-HV-100A	>35 Combination	0.85 Combination	WR051779
			MOV-HV-100B			
			MOV-HV-102			
92	Containment Atmosphere Cleanup	C	TV-HC-104A	0	0	
			TV-HC-104B	0	0	
			TV-CV-150C	0	0	
			TV-CV-150D	0	0	
93	Containment Atmosphere Cleanup	C	TV-CV-150A	0	0	WR043555
			TV-CV-150B	0	0	WR043554
			TV-HC-106A	0	0	
			TV-HC-106B	0	0	
94	Containment Vacuum	C	TV-CV-100	0	0	
			TV-CV-4	0	0	
97A	Pressurizer Dead Weight Calibrator	C	1-RC-176	0	0	Changed penetration number from 97B
			1-RC-178	0	0	
97B	Leakage Monitoring	C	TV-LM-100B	0	0	Changed penetration number from 97C
			TV-LM-100A	0	0	
97C	Sample System	C	TV-SS-103A	0	0	Changed penetration number from 97A
			TV-SS-103B	0	0	
98A	Containment Atmosphere Cleanup	C	TV-HC-108A	0	0	
			TV-HC-108B	0	0	

1984 LOCAL LEAKAGE RATE TEST PENETRATION DATA

Penetration		Type Test	Equipment/Valves Tested	Prerepair Leakage (scfh)	Postrepair Leakage (scfh)	Repair/Notes
98B	Containment Atmosphere Cleanup	C	TV-HC-100A	0	0	
			TV-HC-100B	0	0	
100	Wet Layup	C	1-WT-491	0	0	
			1-WT-488	1.4	0	WR051722
103	Reactor Cavity Purification	C	1-RP-28	0.5	0	Tightened valve
			1-RP-26	0.5	0	Tightened valve
104	Reactor Cavity Purification	C	1-RP-6	0	0	
			1-RP-8	0	0	
105A	Leakage Monitoring	C	TV-LM-100D	0	0	
			TV-LM-100C	0	0	
105B	Leakage Monitoring	C	TV-LM-101B	0	0	
			TV-LM-101C	0	0	
105C	Leakage Monitoring	C	TV-LM-101D	0	0	
			TV-LM-101A	0	0	
105D	Containment Atmosphere Cleanup	C	TV-HC-102A	0	0	
			TV-HC-102B	0	0	
106B	Safety Injection	C	TV-1842	0	0	
			TV-1859	0	0	
108	Wet Layup	C	1-WT-514	27.32	8.45	WR051765
			1-WT-511	0.77	0.77	

ATTACHMENT 4A (Cont)

1984 LOCAL LEAKAGE RATE TEST PENETRATION DATA

Penetration		Type Test	Equipment/Valves Tested	Prerepair Leakage (scfh)	Postrepair Leakage (scfh)	Repair/Notes
109	Containment Atmosphere	C	1-HC-18	2.38	0.63	WR
			TV-HC-103A, B	0	0	
			TV-HC-107A, B	0.2	0.2	
111	Sample System	C	1-DA-66	0	0	
			TV-DA-103A	0	0	
			TV-DA-103B	0	0	
113B	Safety Injection	C	1-SI-90	0	0	
			MOV-1869B	0	0	
114B	Safety Injection	C	1-SI-201	0	0	
			MOV-1869A	0	0	
	Electrical Penetrations	B		>0.054 (18) <0.054 (110)	1.55	18 of 128 electrical penetrations exceeded the plant administrative limit of 0.054 scfh. These were retorqued and retested.
	Equipment Hatch	B			0	
	Fuel Transfer Tube	B			0	
	Personnel Air Lock	B			3.8	
	Emergency Escape Lock	B			1.4	

ATTACHMENT 4B

1983 LOCAL LEAKAGE RATE TEST PENETRATION DATA

Penetration		Type Test	Equipment/Valves Tested	Prerepair Leakage (scfh)	Postrepair Leakage (scfh)	Repair/Notes
79	Service Water	C	MOV-SW-103D	>11	0	
80	Service Water	C	MOV-SW-103C	>11	0	
81	Service Water	C	MOV-SW-103B	0	0	
82	Service Water	C	MOV-SW-103A	>11	0	
83	Service Water	C	MOV-SW-104D	>11	0	
84	Service Water	C	MOV-SW-104C	>11	0	
85	Service Water	C	MOV-SW-104B	0	0	
86	Service Water	C	MOV-SW-104A	>11	0	
	Personnel Air Lock	B			1.4 (6/83) 0 (12/83)	
	Emergency Escape Work	B			0.4 (6/83) 4.3 (12/83)	

ATTACHMENT 4C

1982 LOCAL LEAKAGE RATE TEST PENETRATION DATA

Penetration		Type Test	Equipment/Valves Tested	Prerepair Leakage (scfh)	Postrepair Leakage (scfh)	Repair/Notes
1	Component Cooling	C	TV-CC-103B	0	0	
2	Component Cooling	C	1-CC-193	>35	0	MR#N1-82-07081021 Replaced valve with similar valve that had S.S. body lug bearings
4	Component Cooling	C	1-CC-198	>35	0	MR#N1-82-07081020 Replaced valve with similar valve that had S.S. body lug bearings
5	Component Cooling	C	TV-CC-103A	0	0	
7B	Safety Injection	C	1-SI-79 MOV-1867C MOV-1867D	2 0 0	0.6 0 0	MR#N1-82-07121131 Cleaned and lapped seats
8	Component Cooling	C	TV-CC-101A TV-CC-101B	0 0	0 0	
9	Air Recirculation Cooling Water	C	1-CC-572	1.5	1.5	
10	Air Recirculation Cooling Water	C	1-CC-559	0.7	0.7	

ATTACHMENT 4C

1982 LOCAL LEAKAGE RATE TEST PENETRATION DATA

Penetration		Type Test	Equipment/Valves Tested	Prerepair Leakage (scfh)	Postrepair Leakage (scfh)	Repair/Notes
11	Air Recirculation Cooling Water	C	1-CC-546	0.9	0.9	
12B	Air Recirculation Cooling Water	C	TV-CC-100B	0	0	
			TV-CC-105B	0	0	
13B	Air Recirculation Cooling Water	C	TV-CC-100C	0	0	
			TV-CC-105C	0	0	
14B	Air Recirculation Cooling Water	C	TV-CC-100A	0	0	
			TV-CC-105A	0	0	
15	Charging	C	1-CH-322	>35	0	MR#N1-82-07121130 Cleaned and Lapped seats
			MOV-1289A	0	0	
16	Component Cooling	C	1-CC-154	0	0	
			TV-CC-104C		0	
17	Component Cooling	C	1-CC-119	0	0	
			TV-CC-104B	0	0	
18	Component Cooling	C	1-CC-84	0	0	
			TV-CC-104A	0	0	
19B	RCP Seal Water	C	1-CH-402	0	0	
			MOV-1380	0	0	
			MOV-1381	0	0	

ATTACHMENT 4C

1982 LOCAL LEAKAGE RATE TEST PENETRATION DATA

Penetration		Type Test	Equipment/Valves Tested	Prerepair Leakage (scfh)	Postrepair Leakage (scfh)	Repair/Notes
20	Safety Injection	C	1-SI-110	0	0	
			1-SI-58	0	0	
22	Safety Injection	C	1-SI-185	0.8	0	MR#N1-82-06071620 Cleaned seat and replaced gasket
			MOV-1836	0	0	
24B	RHR	C	1-RH-36	1.1	1.1	
			1-RH-37	1.4	1.4	
25	Component Cooling	C	TV-CC-102E	0	0	
			TV-CC-102F	0	0	
26	Component Cooling	C	TV-CC-102A	1.0	1.0	
			TV-CC-102B	0	0	
27	Component Cooling	C	TV-CC-102C	0	0	
			TV-CC-102D	0	0	
28B	Letdown	C	RV-1203	0	0	
			HCV-1200A, B, C	>35	11.4	MR#N1-82-08051415 Machined disc and seat MR#N1-82-08051416 Machined disc and seat MR#N1-82-08051417 Machined disc and seat
			HCV-1142	0	0	
			TV-1204	0	0	

ATTACHMENT 4C

1982 LOCAL LEAKAGE RATE TEST PENETRATION DATA

Penetration		Type Test	Equipment/Valves Tested	Prerepair Leakage (scfh)	Postrepair Leakage (scfh)	Repair/Notes
31	Containment Atmosphere Cleanup	C	1-HC-14 TV-HC-105A	0 0	0 0	New isolation valve
			TV-HC-101A	0	0	New isolation valve
32	Wet Layup	C	1-WT-468 1-WT-465	0 0	0 0	
33	Primary Drains	C	TV-DG-100A TV-DG-100B	0.5 0	0.5 0	
34	Fire Protection	C	1-FP-275 1-FP-274	0 0	0 0	
38	Containment Sump Pump Discharge	C	TV-DA-100A TV-DA-100B	0.3 0.8	0.3 0.8	
39	Blowdown	C	TV-BD-100A	>11.2	0	MR#N1-82-06021733 New seat ring and gaskets, lapped plug and seat ring, repacked
		C	TV-BD-100B	0	0	
40	Blowdown		TV-BD-100E	0 >11.2	0 0	MR#N1-82-06021730 New gaskets
		C	TV-BD-100F	0	0	

ATTACHMENT 4C

1982 LOCAL LEAKAGE RATE TEST PENETRATION DATA

Penetration		Type Test	Equipment/Valves Tested	Prerepair Leakage (scfh)	Postrepair Leakage (scfh)	Repair/Notes
41	Blowdown		TV-BD-100C	0.7	0.7	MR#N1-82-06021732
				>11.2	0	Cleaned, new seat ring reset stroke, new gaskets
		C	TV-BD-100D	0	0	
42	Service Air		1-SA-2	0.6	0.6	Valves renumbered
			1-SA-29	0	0	
43	Air Sample	C	TV-RM-100D	0	0	
			TV-RM-100A	0	0	
44	Air Sample	C	1V-RM-100B	0	0	
			TV-RM-100C	0	0	
45	PG Water	C	1-RC-149	0.7	0.6	MR#N1-82-06091435 Cleaned and lapped valve
		C	TV-1519A	0	0	
46B	Loopfill		1-CH-330	0	0	MR#N1-82-06071652
			FCV-1160	>11.2	0	New seat gaskets and repacked
47	Instrument Air	C	1-IA-55	0.7	0.4	MR#N1-82-06170330
			TV-IA-102B	0	0	
48	Primary Vent Header	C	TV-VC-100A	0	0	
			TV-VG-100B	0	0	

ATTACHMENT 4C

1982 LOCAL LEAKAGE RATE TEST PENETRATION DATA

Penetration		Type Test	Equipment/Valves Tested	Prerepair Leakage (scfh)	Postrepair Leakage (scfh)	Repair/Notes
50	Safety Injection	C	HCV-1936	0	0	
			TV-SI-101	0	0	
53	Safety Injection	C	1-SI-106	0	0	
			TV-SI-100	0	0	
54	Primary Vent	C	1-DA-39	0	0	
			1-DA-41	0	0	
55A	Sample System	C	TV-SS-104A	0	0	
			TV-SS-104B	0	0	
55B	Leakage Monitoring	C	TV-LM-100E	0	0	
			TV-LM-100F	0	0	
56A	Sample System	C	TV-SS-102A	0	0	
			TV-SS-102B	0	0	
56B	Sample System	C	TV-SS-106A	0	0	
			TV-SS-106B	0	0	
56C	Sample System	C	TV-SS-100A	0	0	
			TV-SS-100B	0	0	
56D	Sample System	C	TV-SS-112A	0	0	
			TV-SS-112B	0	0	
57A	Leakage Monitoring	C	TV-LM-100G	0	0	
			TV-LM-100H	0	0	

ATTACHMENT 4C

1982 LOCAL LEAKAGE RATE TEST PENETRATION DATA

Penetration		Type Test	Equipment/Valves Tested	Prerepair Leakage (scfh)	Postrepair Leakage (scfh)	Repair/Notes
57B	Sample System	C	TV-SS-101B	0	0	
			TV-SS-101A	0	0	
60B	Safety Injection	C	1-SI-207	0	0	
			MOV-1890B	0	0	
61B	Safety Injection	C	1-SI-206	0	0	
			MOV-1890A	0	0	
62	Safety Injection	C	MOV-1890C	0	0	
			MOV-1890D	0	0	
			1-SI-197	0	0	
			1-SI-199	0.3	0.3	
			1-SI-195	1.5	1.5	
63	Quench Spray	C	MOV-QS-101B	0	0	
			1-QS-19	0	0	
64	Quench Spray	C	MOV-QS-101A	0	0	
			1-QS-11	0	0	
66B	Recirculation Spray	C	MOV-RS-100A	>11.2	2.0	MR#N1-82-06081755
			MOV-RS-101A	0	0	
67B	Recirculation Spray	C	MOV-RS-100B	0	0	
			MOV-RS-101B	0	0	
70	Recirculation Spray	C	MOV-RS-156B	1.6	1.6	
			1-RS-27	1.4	1.4	

ATTACHMENT 4C

1982 LOCAL LEAKAGE RATE TEST PENETRATION DATA

Penetration		Type Test	Equipment/Valves Tested	Prerepair Leakage (scfh)	Postrepair Leakage (scfh)	Repair/Notes
71	Recirculation Spray	C	MOV-RS-156A 1-RS-18	1.6 0	1.6 0	
79	Service Water	C	MOV-SW-103D	0	0	
80	Service Water	C	MOV-SW-103C	0	0	
81	Service Water	C	MOV-SW-103B	0	0	
82	Service Water	C	MOV-SW-103A	0	0.	
83	Service Water	C	MOV-SW-104D	0	0	
84	Service Water	C	MOV-SW-104C	0	0	
85	Service Water	C	MOV-SW-104B	0	0	
86	Service Water	C	MOV-SW-104A	0	0	
89	Air Ejector	C	TV-SV-102-1 TV-SV-103	0 >11.2	0 0	 MR#N1-82-06180341 Replaced disc seat, retainer and gasket
90	Purge	C	MOV-HV-100C MOV-HV-100D MOV-HV-101	19.3 Combination	19.3 Combination	
91	Purge	C	MOV-HV-100A MOV-HV-100B MOV-HV-102	20.5 Combination	20.5 Combination	

ATTACHMENT 4C

1982 LOCAL LEAKAGE RATE TEST PENETRATION DATA

Penetration		Type Test	Equipment/Valves Tested	Prerepair Leakage (scfh)	Postrepair Leakage (scfh)	Repair/Notes
92	Containment Atmosphere Cleanup	C	TV-HC-104A	0	0	New isolation valve
			TV-HC-104B	0	0	New isolation valve
			TV-CV-150C	0	0	
			TV-CV-150D	0	0	
93	Containment Atmosphere Cleanup	C	TV-CV-150A	0	0	
			TV-CV-150B	0	0	
			TV-HC-106A	0	0	New isolation valve
			TV-HC-106B	0	0	New isolation valve
94	Containment Vacuum	C	TV-CV-100	0	0	
			TV-CV-4	0	0	
97A	Sample System	C	TV-SS-103A	0	0	New isolation valve
			TV-SS-103B	0	0	
97B	Pressurizer Dead Weight Calibrator	C	1-RC-176	0	0	
			1-RC-178	0	0	
97C	Leakage Monitoring	C	TV-LM-100B	0	0	
			TV-LM-100A	0	0	
98A	Containment Atmosphere Cleanup	C	TV-HC-108A	0	0	
			TV-HC-108B	0	0	
98B	Containment Atmosphere Cleanup	C	TV-HC-100A	0	0	
			TV-HC-100B	0	0	
100	Wet Layup	C	1-WT-491	0	0	
			1-WT-488	0	0	

ATTACHMENT 4C

1982 LOCAL LEAKAGE RATE TEST PENETRATION DATA

Penetration		Type Test	Equipment/Valves Tested	Prerepair Leakage (scfh)	Postrepair Leakage (scfh)	Repair/Notes
103	Reactor Cavity Purification	C	1-RP-28	0	0	
			1-RP-26	0	0	
104	Reactor Cavity Purification	C	1-RP-6	0	0	
			1-RP-8	0	0	
105A	Leakage Monitoring	C	TV-LM-100D	0	0	
			TV-LM-100C	0	0	
105B	Leakage Monitoring	C	TV-LM-101B	0	0	
			TV-LM-101C	0	0	
105C	Leakage Monitoring	C	TV-LM-101D	0	0	
			TV-LM-101A	0	0	
105D	Containment Atmosphere Cleanup	C	TV-HC-102A	0	0	
			TV-HC-102B	0	0	
106B	Safety Injection	C	TV-1842	0.4	0	MR#N1-82-06180342 Replaced valve stem plug, seat ring, and gaskets
		C	TV-1859	0	0	
108	Wet Layup		1-WT-514	0	0	
			1-WT-511	0	0	

ATTACHMENT 4C

1982 LOCAL LEAKAGE RATE TEST PENETRATION DATA

Penetration		Type Test	Equipment/Valves Tested	Prerepair Leakage (scfh)	Postrepair Leakage (scfh)	Repair/Notes
109	Containment Atmosphere	C	1-HC-18	0	0	
			TV-HC-103A	0	0	New isolation valve
			TV-HC-107A	0	0	New isolation valve
111	Sample System	C	TV-DA-103A	0	0	New isolation valve
			TV-DA-103B	0	0	New isolation valve
113B	Safety Injection	C	1-SI-90	0	0	
			MOV-1869B	0	0	
114B	Safety Injection	C	1-SI-201	1.0	0.5	MR#N1-82-06071621 New cover gasket
		B	MOV-1869A	0	0	
	Electrical Penetrations			>0.054(4) <0.054(125)	1.44	5 of 129 electrical penetrations exceeded the plant administrative limit of 0.054 scfh. These were retorqued and retested.
	Equipment Hatch	B			0	
	Fuel Transfer Tube	B				
	Personnel Air Lock	B			0	
	Emergency Escape Lock	B			0	

ATTACHMENT 4D

1981 LOCAL LEAKAGE RATE TEST PENETRATION DATA

Penetration		Type Test	Equipment/Valves Tested	Prerepair Leakage (scfh)	Postrepair Leakage (scfh)	Repair/Notes
16	Component Cooling	C	1-CC-154	0	0	
17	Component Cooling	C	1-CC-119	0	0	
18	Component Cooling	C	1-CC-84	0	0	
41	Blowdown	C	TV-BD-100D	0	0	
56B	Sample System	C	TV-SS-106A TV-SS-106B	0	0	
98A	Containment Atmosphere Cleanup	C	TV-HC-108A TV-HC-108B	0 0	0 0	New isolation valves Reference DC 80-S31A
98B	Containment Atmosphere Cleanup	C	TV-HC-100A TV-HC-100B	0 0	0 0	New isolation valves Reference DC 80-S31A
105D	Containment Atmosphere Cleanup	C	TV-HC-102A TV-HC-102B	0 0	0 0	New isolation valves Reference DC 80-S31A
	Personnel Air Lock	B			0 (6/81) 1.4 (12/81)	
	Emergency Escape Lock	B			2.4 (12/82)	

ATTACHMENT 1

LOCAL LEAKAGE RATE TEST SUMMARY ANALYSIS

A request was made by the Nuclear Regulatory Commission (Reference NRC Report 50-338/84-29) to assess the "as-found" containment leakage condition.

The evaluation of the "as-found" containment leakage conditions requires an analysis of the containment penetrations repaired prior to the August 1984 CILRT. The details of this analysis are shown on the following pages. Information for the 1982, 1983, and 1984 Local Leakage Rate Tests is also presented.

A conservative analysis indicates that certain penetrations could potentially impact the "as-found" Type A test results. Although the North Anna No. 1 1984 CILRT is considered a failure, it is believed that the following actions will prevent this situation from happening again:

1. Evaluate potential modifications for the recirculation spray coolers to address the problems identified in North Anna's LER 84-008, Recirculation Spray Cooler Lap Ring Cracking.

2. Review the North Anna Work Control Program to determine if adequate controls exist to prevent maintenance on a Local Leakage Rate Test (LLRT) component after the LLRT, unless post-work testing is specified.

3. Evaluate the test equipment used for LLRTs in order to provide capability for measuring seat leakage up to the equivalent of the maximum allowable leakage (LA) in scfh.

4. Review the LLRT procedure for those penetrations that use the downstream leakage test method to require either a leakage test of the test boundary prior to the isolation valve test, or to perform a combination makeup test and downstream measurement(s) to account for all leakage.

5. Review the LLRT procedure to require a demonstration of where the leakage path is (e.q., is it leaking to the inside of containment or to the outside of containment).

6. Initiation of a valve repair summary.

Vepco will perform these evaluations. It is anticipated that the results of the LLRT evaluations/reviews will be completed by March 31, 1985, based on current work schedules. The results of these evaluations will be reported separately by letter and not as an addendum to this report. Since these evaluations/reviews address LLRT concerns identified during the CILRT, additional CILRTs beyond the normal Appendix J, 10CFR50 cycle is not warranted.

The following analysis reviews the Local Leakage Rate Test results performed since the Unit 1 March 1981 CILRT. This analysis is based on the repairs performed on the containment isolation valves. Each penetration is reviewed using the following criteria:

1. A leakage equivalent to the repair improvement achieved on each valve is calculated.

2. The leakage equivalent is the difference between the "as-found" and the "as-left" LLRT result.

3. If a repair was not required, a zero leakage equivalent is assessed to the valve.

4. The leakage equivalent assessed to a penetration may be reduced due to the safety-related service of the penetration. Justification for these penetrations is provided.

5. The net equivalent leakage for the penetration is the lowest of inside or outside valve grouping (e.g., simulates minimum pathway leakage).

6. A summary sheet for each outage is included.

   NOTE: There were no repairs made in 1981, thus no summary sheet is included.

CONCLUSION

Based on a review of the 1982, 1983, and 1984 LLRTs, the following corrective action is recommended:

1. A review of the NAPS Work Control Program to prevent maintenance on a LLRT component after the LLRT unless post-walk testing is specified.

2. A requirement in the LLRT procedure to provide capability for measuring seat leakage up to the equivalent of the maximum allowable leakage, La.

3. A review of test procedure for those penetrations that use the downstream leakage test method to require either a leakage test of the test boundary prior to the isolation valve test, or perform a combination makeup test and downstream measurement(s) to account for all leakage.

4. A review of the test procedure to require a demonstration of where the leakage path is (e.g., inside or outside containment).

5. Initiation of a valve repair summary to feed a valve betterment program.

1984 LLRT SUMMARY ANALYSIS

Penetration		Inside	Outside	Net (scfh)	Remarks
7	Safety Injection	0	NA	0	Motor on MOV-1867D was inoperable. As-found test not possible
9	Air Recirculation Cooler Cooling Water	-	>35	>35	
11	Air Recirculation Cooler Cooling Water	-	>35	>35	
14B	Air Recirculation Cooler Cooling Water	0		0	
16	Component Cooling	>35	0	0	
17	Component Cooling	>35	0	0	
28B	Letdown	>35	0	0	
31	Containment Atmosphere Cleanup	>35	3.1	3.1	
32	Wet Layup	0	2.1	0	
40	Blowdown	5.59	0	0	
46B	Loop Fill	>35	>35	0	See Note 3
53	Safety Injection		0	0	
66B	Recirculation Spray	0	10.8	0	0
71	Recirculation Spray	0	3.3	0	0
79	Service Water	-	>35	0	See Note 4
83	Service Water	-	0.42	0	See Note 4
89	Air Ejector	2.8	0	0	
90	Purge	>35	>35	>35	See Note 5
91	Purge	>35	>35	>35	See Note 5
100	Wet Layup	1.4	0	0	

103 Reactor Cavity Purification	0.5	0.5	0.5	
Penetration	Inside	Outside	Net (scfh)	Remarks
108 Wet Layup	0	18.87	0	
109 Containment Atmosphere Cleanup	1.75	0	0	

NOTES:

1. Adding the net equivalent leakage of >211.99 scfh or >0.074091%/day to the "As-found" Type A results of the September 1984 CILRT, indicates that the plant allowable of 0.1%/day was exceeded.

2. Greater than 35 scfh represents the largest flowmeter used for the 1984 LLRT program.

3. This line is from the charging pump header and is used to fill the loops. The charging pumps are used as the high head safety injection pumps. The chemical and volume control system valves, piping, and components have been designed to permit essentially zero leakage. Periodic surveillance is performed to verify leakage is within specifications. Reference North Anna UFSAR Section 6.3.3.6, External Recirculation loop.

4. The Service Water piping to the Recirculation Spray Heat Exchangers.

5. The purge supply and exhaust valves consist of a T arrangement (e.g. one valve inside and 2 valves in parallel outside). Each penetration is tested by pressurizing between the inside and outside valves. No attempt to quantify whether the leakage path is through the inside or outside valve is required by the LLRT procedure.

1982 LLRT SUMMARY ANALYSIS

Penetration	Inside	Outside	Net (scfh)	Remarks
2 Component Cooling	-	>35	>35	
4 Component Cooling	-	>35	>35	
7 Safety Injection	1.4	0	0	
15 Charging	>35	0	0	
22 Safety Injection	0.8	0	0	
28B Letdown	>35	0	0	
39 Blowdown	>35	>11.2	0	
40 Blowdown	0	>11.2	0	
41 Blowdown	0	>11.2	0	
45 PG Water	0.1	0	0	
55 Instrument Air	0.3	0	0	
66B Recirculation Spray	0	>11.2	0	
106B Safety Injection	0.4	0	0	
114B Safety Injection	0.5	0	0	

NOTE: The resulting net equivalent leakage of >70 scfh or 0.024465%/day indicates that the plant allowable leakage rate limit of 0.1%/day may have been exceeded.

1983 LLRT SUMMARY ANALYSIS

Penetration	Inside	Outside	Net (scfh)	Remarks
79 Service Water	-	>11	0	See Note 1
80 Service Water	-	>11	0	See Note 1
82 Service Water	-	>11	0	See Note 1
83 Service Water	-	>11	0	See Note 1
84 Service Water	-	>11	0	See Note 1
86 Service Water	-	>11	0	See Note 1

Net equivalent leakage 0

NOTE

1. The full range of the rotometer used to test these valves was 11 scfh. Reference Note 4 on the 1984 LLRT Summary Analysis.